Groundwater Remediation—A Holistic Approach

The holistic approach, or using an integrated whole to create an outcome that is independent of and greater than the sum of its parts, is nothing new. However, using the holistic approach to stabilize uranium mill tailings and to remediate contaminated groundwater is a new concept that the Uranium Mill Tailings Remedial Action (UMTRA) Ground Water Project and the U.S. Department of Energy Grand Junction Office (DOE–GJO) are sharing with remedial project managers around the world.

Representatives of International Atomic Energy Agency member states meet to plan the guidance document on the holistic approach to groundwater remediation.

Federal and contractor UMTRA Ground Water Project personnel at DOE–GJO are involved in a 4-year endeavor with representatives from 14 other countries to prepare a document about the holistic approach to remediation. "We submitted a proposal for a Coordinated Research Project to the International Atomic Energy Agency (IAEA) and it was accepted," said Donald Metzler, DOE–GJO Project Manager of the UMTRA Ground Water Project. The outcome of this endeavor will be a guidance document based on input and case studies contributed by representatives of 14 of the 130 IAEA member states. The organization envisions the guidance document as a vehicle to share practical experiences and to transfer technologies that will benefit all member states.

The DOE–GJO UMTRA Ground Water Project became involved in this holistic effort through Metzler's association with Dr. Eberhart Falck, a world-renowned geochemist from Germany, who is manager of this particular Coordinated Research Project in the Waste Technology Section of IAEA. "We are realizing the value of applying the holistic approach to mill tailings remediation projects," said Metzler. "The IAEA team agrees it's important to look at the cultural risks and socioeconomic impacts before making decisions about the cleanup of mill tailings and groundwater."

International Atomic Energy Agency

IAEA is an independent intergovernmental science- and technology-based organization that serves as the global focal point for nuclear cooperation. The organization was established as an autonomous organization under the United Nations in 1957 and maintains its headquarters in Vienna, Austria.

According to IAEA, the guidance document *Technologies and Methods for Long-Term Stabilization and Isolation of Uranium Mill Tailings* helps fulfill the organization's objective to share adaptive research results and applied research and development work by member states. The document is proposed as one step toward raising the awareness of potential problems, assisting member states in the development of efficient procedures and processes for the sustainable long-term management and

remediation (if appropriate) of uranium mining and milling waste sites, and encouraging a harmonious and systematic approach where feasible.

Guidance Document

An outline of the planned document created by the UMTRA Ground Water Project team members was well received. The outline divided the process of applying the holistic approach to remediation of groundwater contamination into seven steps: initial scoping; emergency and interim actions; planning; site characterization; remedial objectives and alternatives; remedial design, actions, and monitoring; and performance evaluation.

The document will present a general framework for performing site assessments, methods and technologies for long-term stabilization of contamination, and project integration. Contributors to the document will base their contributions on lessons learned and cumulative knowledge garnered from work on remediation projects, such as the UMTRA Surface and Ground Water Projects and the Monticello, Utah, Projects in the United States. The emphasis of this document is solutions, and it will address such topics as how long a disposal cell should last and what to expect of its performance.

Initial scoping consists of defining the problem through historical reviews and site inspections, assessing the potential and immediate risks, and preparing a summary report. Emergency and interim actions are implemented to remove unacceptable risks. Examples include alternate water supplies, physical barriers, and institutional controls to control access to the water.

Planning includes several substeps. Short-term and long-term goals and objectives are defined to attain regulatory limits, meet schedules and budget requirements, and determine future land uses. Planning also involves identifying various stakeholders, such as property owners, regulatory agencies, and state and local governments. All applicable regulations associated with the cleanup of groundwater contamination are also identified. Part of the planning process includes identifying potential remedies. For the UMTRA Ground Water Project, there are three potential remedies: no action with monitoring, natural flushing with monitoring, and active remediation. Each of these remedies has been applied either alone or in some combination at various sites in the project. The last step in the planning process is the preparation of management plans and technical plans. Management plans ensure consistency among project tasks and ensure that consensus among stakeholders is obtained. Technical plans describe fieldwork, procedures, and results of data evaluations.

The next step in the holistic approach is site characterization. Field investigations are conducted at each site to prepare land surveys and base maps, collect field data, and perform laboratory analyses. Geographical information system databases that contain information on the locations of geographical features, the types of samples and analytical results, and property improvements are developed for the project. These data are evaluated and reports are then created that include information on the nature and extent of the identified contamination, site conceptual models, and environmental and human health risk assessments.

Remedial objectives and alternatives are developed based on regulations, risk, and desired quality of the groundwater. Each remedial alternative is evaluated for effectiveness, potential for implementation, and cost. An alternative is selected that provides the best balance of the evaluation criteria. The remedial decision and rationale are documented and made available for public review.

The remedial design depends on the remediation approach. Remedial action for natural flushing is limited to installation of additional monitor wells and predictive modeling. Active remediation involves installation of extraction wells and construction of a treatment system. Long-term monitoring of the groundwater is required for all remedies.

The final step in the holistic approach is performance evaluation, which includes monitoring, verification, and closeout. Not only are the contaminant concentrations monitored through sampling and analysis, but changes in physical boundaries and compliance with institutional controls are also monitored. The effectiveness of the remediation is verified, and modeled predictions are compared to the cleanup objectives. The site is closed out when remediation is complete and the goals have been achieved.

"For the UMTRA Ground Water Project, the holistic approach integrates characterization, design, and remediation of groundwater contamination; planning; public involvement; and permitting that result in better achievement of long-term goals and objectives," said Metzler. A draft holistic guidance document is scheduled to be complete in June 2001, and a final holistic guidance document is anticipated to be issued in June 2004.

For more information about the holistic approach to groundwater remediation or the UMTRA Ground Water Project in general, contact Donald Metzler at (970) 248–7612.❖

Michael Tucker, the U.S. Department of Energy Grand Junction Office (DOE–GJO) Certification Officer, signed the last Uranium Mill Tailings Remedial Action (UMTRA) Vicinity Property certification letter on September 29, 2000. Overall, DOE certified 4,302 properties in Grand Junction, Colorado, and 137 properties in Edgemont, South Dakota, for a total of 4,439 properties. This action completes all certification requirements pertaining to approximately 15 years of UMTRA Project remediation work managed by DOE–GJO.❖